Presenting

A LINE OF

MODERN
COAL-BURNING STEAM
LOCOMOTIVES

World's Newest Locomotive

DECEMBER 1944

PENNSYLVANIA RAILROAD

Always Searching for New Things—and Finding Them

PRR

The Pennsylvania Railroad Presents...

A LINE OF

MODERN COAL-BURNING STEAM LOCOMOTIVES

Progress in the art of railroad transportation, throughout the development of the industry, has been achieved by research.

The railroads have kept in the van of technological progress, not only by constantly engaging in original work of their own, but also by diligently following the development of every branch of science and engineering for discoveries and advances adaptable to railroad use.

The policy of the Pennsylvania Railroad—the world's largest transportation system—is, and always has been, to build for the future, and thus anticipate transportation needs. Because bituminous coal is the most economical fuel, and is abundant and of high quality in Pennsylvania Railroad territory, this railroad has naturally, throughout its history, been deeply concerned with the development and constant improvement of the coal-burning steam locomotive, which is its standard source of motive power, except in the eastern seaboard territory, where, owing to the great density of traffic, electrification became desirable.

In addition to the many highly advanced types of steam locomotives already in regular service on the Pennsylvania, this railroad now presents a fundamentally new type of coal-burning steam locomotive . . .

FIRST DIRECT DRIVE STEAM TURBINE LOCOMOTIVE EVER BUILT IN THE UNITED STATES

AMERICA'S NEWEST TYPE LOCOMOTIVE—HOW IT OPERATES

THE new class S-2 coal-burning steam locomotive differs from locomotives of conventional design in that it is powered by a turbine instead of reciprocating engines. It is the first direct drive steam turbine locomotive ever built in the United States, and is now undergoing tests to determine the adaptability of this type of engine to the Pennsylvania's long-distance high-speed passenger and freight service.

In the new locomotive, the turbine shaft is rotated by the pressure of jets of steam against the blades of the turbine wheel, and a continuous flow of power is transmitted to the driving wheels through speed reducing gears. A product of continuing research and development, the engine was designed and constructed by the Baldwin Locomotive Works and the Westinghouse Electric and Manufacturing Company, in collaboration with the Pennsylvania Railroad.

Development of the new steam turbine locomotive follows the placing in service of several other new types of coal-burning steam engines for test and observation.

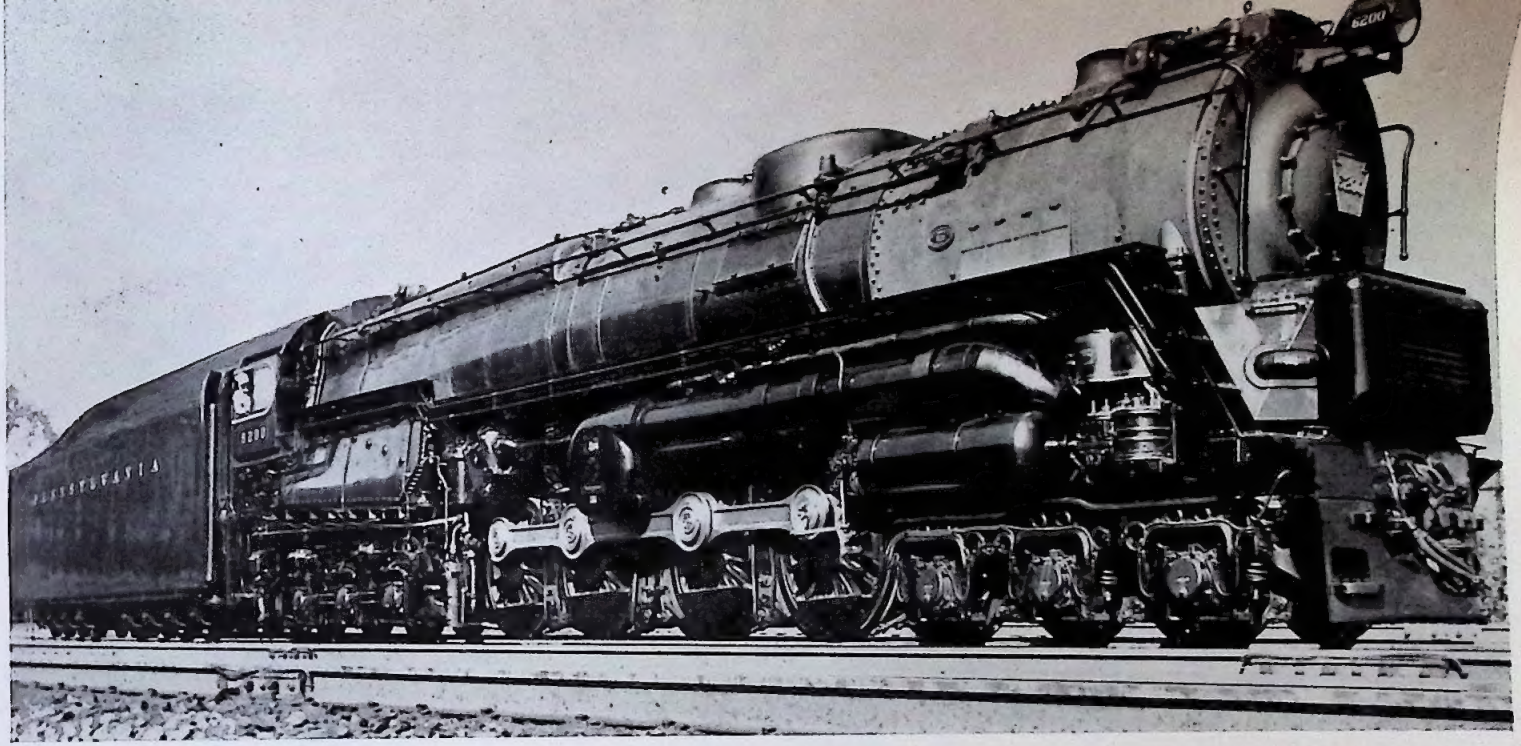
The purpose of developing the new steam turbine locomotive is to eliminate the reciprocating parts of the conventional steam locomotive, obtain a uniform flow of power to the driving wheels, and to secure the economies inherent in a turbine for railroad motive power. The turbine is designed to develop 6,900 shaft horsepower, providing power sufficient to pull a full-length passenger train at 100 miles an hour and high class freight trains at high speeds.

A feature of the new engine is its simple operation. Both forward and reverse movements, at all speeds, are controlled by a single lever, actuating specially designed pneumatic control apparatus. Automatically functioning devices make incorrect handling of the mechanism impossible.

The Turbine Drive

Comparatively small and accounting for less than 1 per cent of the locomotive's total weight, the main, or forward drive, turbine is mounted at the right hand side of the locomotive. A smaller turbine, designed to move the locomotive backward at speeds up to 22 miles an hour, is mounted on the left side, and is brought into operation by engaging a clutch.

There are more than 1,000 chromium steel blades in the forward turbine, some of which are less than one inch long. Steam travels through the entire battery of turbine blades, expending all of its energy except approximately 15 pounds, which produces a non-pulsating draft through the firebox and boiler. The boiler is of the conventional type, carrying 310 pounds of steam pressure and fired by mechanical stoker.



AMERICA'S NEW DIRECT DRIVE STEAM TURBINE LOCOMOTIVE—PENNSYLVANIA RAILROAD

Pennsylvania Class S-2

Length overall, from coupler face to coupler face, 122 feet, 7¼ inches—Height, 16 feet.
Steam Turbine, Direct Drive (No Cylinders)
Steam Pressure, 310 pounds per square inch
Driving Wheel Diameter, 68 inches

Wheel Arrangement 6-8-6

Weight on Driving Wheels, 260,000 pounds
Total Weight of Locomotive and Tender in Working Order, 1,032,100 pounds
Tractive Effort, 65,000 pounds
Capacity of Tender, 85,000 pounds of Coal, 19,500 gallons of Water

COAL-BURNING STEAM TURBINE LOCOMOTIVE for Passenger or Freight Service

The heat-treated alloy steel reducing gears, into which the turbine shaft feeds its power, operate continuously in an oil bath and mesh with so little friction that 97 per cent of the turbine's power reaches the driving wheels. Power is applied directly to two center pairs of driving wheels and transmitted to two additional pairs of drivers by connecting rods. The engine has a 6-8-6 wheel arrangement, by which is meant six leading wheels, eight driving wheels, and six trailing wheels. It is equipped with roller bearings throughout.

Multiple-Cylinder Locomotives

The Pennsylvania Railroad's newest four-cylinder coal-burning steam passenger locomotive, designated Class T-1, has been operated at speeds up to 120 miles an hour on the test plant at Altoona, Pa. Two locomotives of this type already are in service on the railroad's fastest passenger trains. They are of unusual streamlined design and have long sweeping lines.

The Pennsylvania Railroad has been developing multiple-cylinder coal-burning steam locomotives for several years, having produced, in addition to the T-1, the S-1—world's largest and fastest passenger locomotive—and the Q-1 and Q-2 freight locomotives.

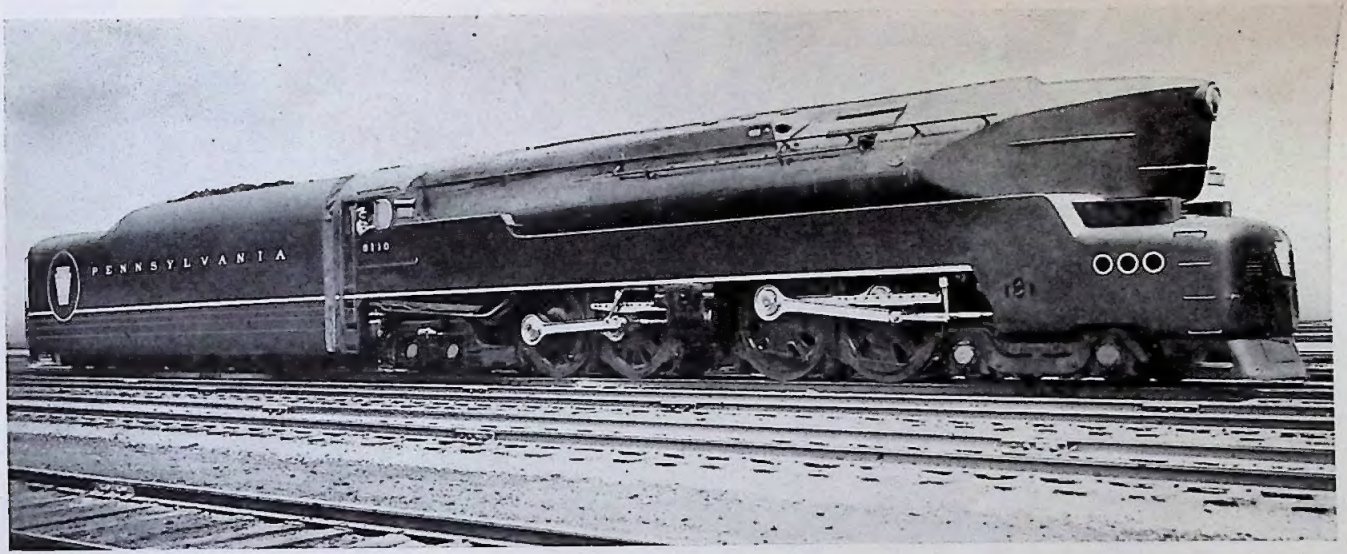
The Q-2 was placed under production during the summer of 1944 by the Pennsylvania at its Altoona Works and 25 have been or will be, constructed on the first order. This locomotive is capable of pulling a train of 125 loaded freight cars at speeds in excess of 50 miles an hour.

The new Q-2 engine has been designed to develop more power in its working range—at speeds over 20 miles an hour—than any steam locomotive ever previously built. It will speed the freight movement in two ways: first by moving heavier trains with increased speeds on the road, and second, by making longer continuous runs without stopping for coal, thus materially increasing over-all train speeds.

The Pennsylvania Railroad's S-1 coal-burning steam passenger locomotive is the streamlined monster of America's railroads. It measures 140 feet, 2½ inches, from the pulling face of the pilot coupler to the pulling face of the tender coupler, and not only is the largest passenger engine in the world, but the swiftest. The S-1 was the first four-cylinder locomotive to be built in the Pennsylvania's present program of developing multiple-cylinder engines.

The Pennsylvania has a large fleet of Class J-1 coal-burning steam freight locomotives. They were built to assist in the prompt movement of war-time freight (World War II).

The M-1a is another coal-burning freight locomotive performing fast freight service. It also does an efficient job on heavy through passenger runs. The K-4s coal-burning passenger locomotive, running in high-speed passenger service, pulls some of the Pennsylvania Railroad's most famous trains. The railroad maintains large fleets of both M-1a and K-4s engines. These locomotives are only a few of the many types in service on the Pennsylvania.



Pennsylvania Class T-1

Length overall, from coupler face to coupler face, 122 feet, 9¾ inches—Height, 15 feet, 6 inches

Cylinders, 19¾-inch diameter, 26-inch stroke

Steam Pressure, 300 pounds per square inch

Driving Wheel Diameter, 80 inches

Wheel Arrangement 4-4-4-4

Weight on Driving Wheels, 268,200 pounds

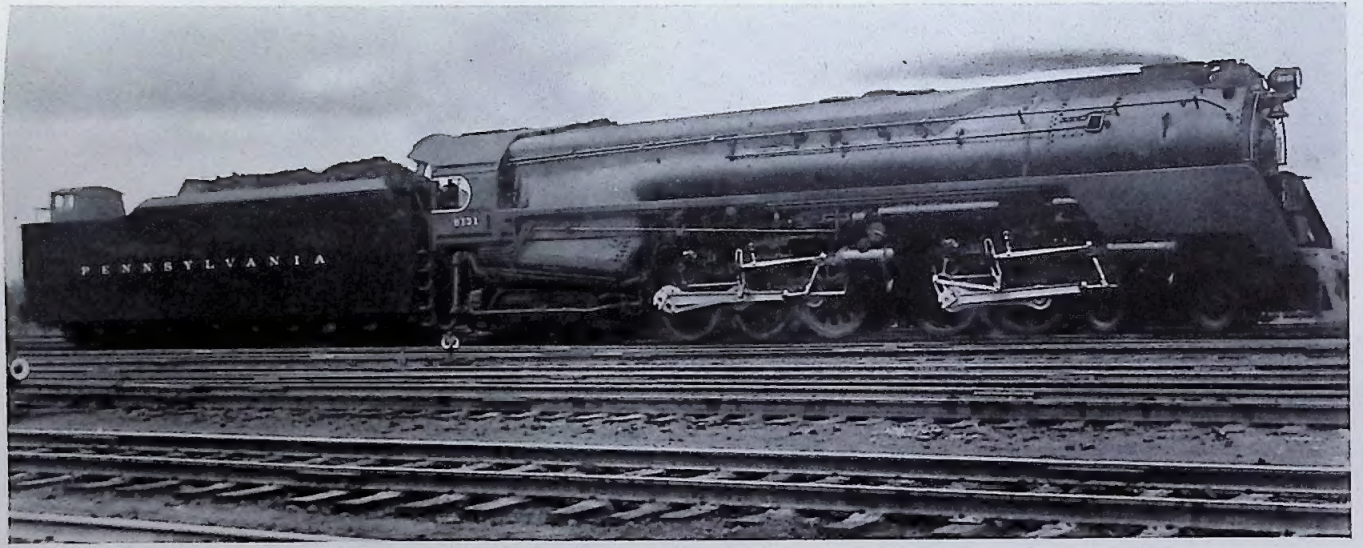
Total Weight of Locomotive and Tender in Working Order, 930,200 pounds

Tractive Effort, 64,650 pounds

Capacity of Tender, 82,000 pounds of Coal, 19,500 gallons of Water.

COAL-BURNING STEAM PASSENGER LOCOMOTIVE

Four Cylinders



COAL-BURNING STEAM FREIGHT LOCOMOTIVE

Four Cylinders

Pennsylvania Class Q-2

Length overall, from coupler face to coupler face, 124 feet, 7⅛ inches—Height, 16 feet, 5½ inches

Cylinders, Front—19¾ inch diameter, 28-inch stroke. Rear—23¾ inch diameter, 29-inch stroke

Steam Pressure, 300 pounds per square inch

Driving Wheel Diameter, 69 inches

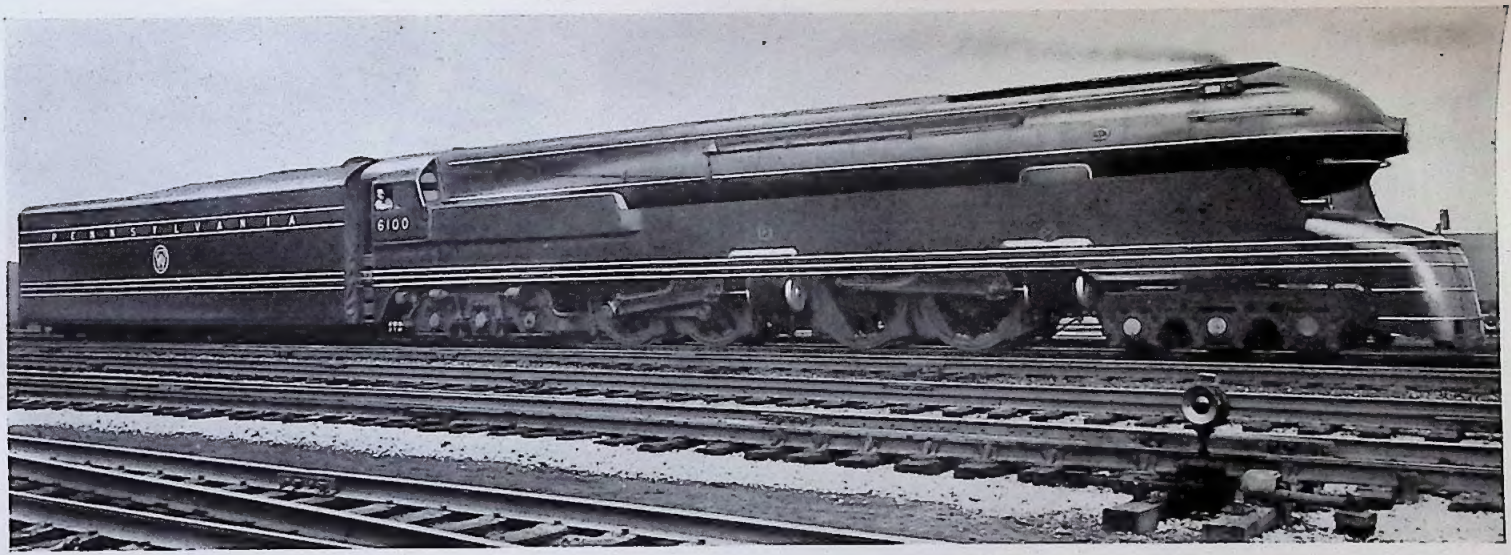
Wheel Arrangement 4-4-6-4

Weight on Driving Wheels, 388,400 pounds

Total Weight of Locomotive and Tender in Working Order, 1,053,100 pounds

Tractive Effort, 99,860 pounds (with Booster, 114,860 pounds)

Capacity of Tender, 79,700 pounds of Coal, 19,020 gallons of Water



WORLD'S LARGEST AND FASTEST COAL-BURNING STEAM PASSENGER LOCOMOTIVE

Pennsylvania Class S-1

Length overall, from coupler face to coupler face, 140 feet, 2½ inches—Height, 15 feet, 6 inches.

Cylinders, 22-inch diameter, 26-inch stroke.

Steam Pressure 300 pounds per square inch.

Driving Wheel Diameter, 84 inches.

Wheel Arrangement 6-4-4-6

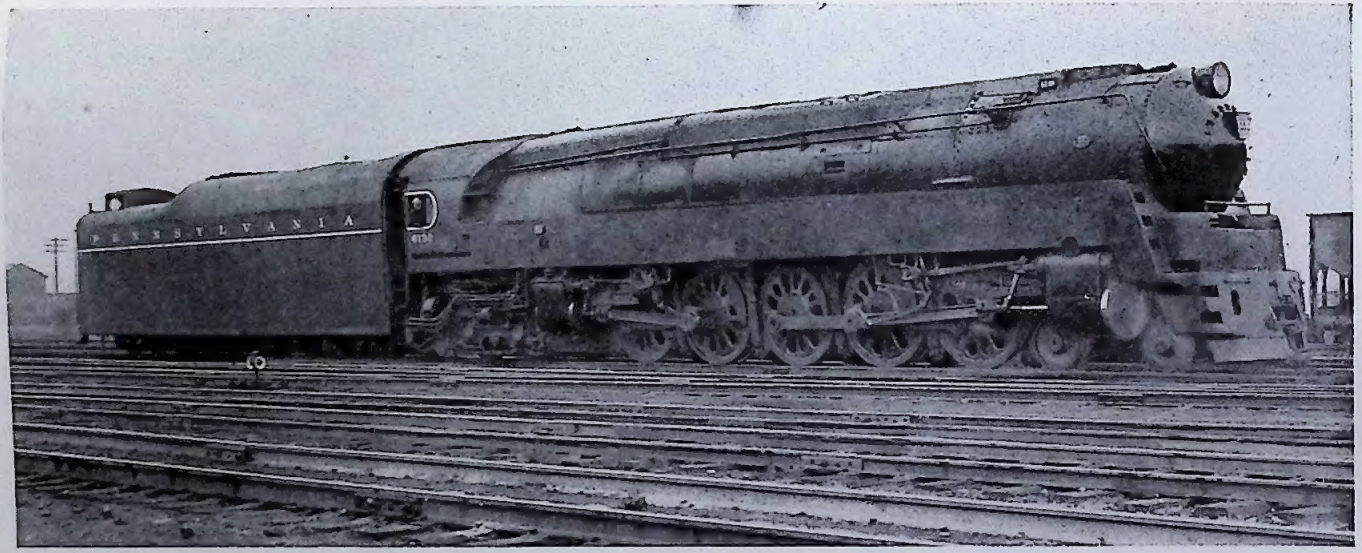
Weight on Driving Wheels, 281,440 pounds

Total Weight of Locomotive and Tender in Working Order, 1,060,010 pounds

Tractive Effort, 71,900 pounds

Capacity of Tender, 52,900 pounds of Coal, 24,230 gallons of Water

Four Cylinders



COAL-BURNING STEAM FREIGHT LOCOMOTIVE

Four Cylinders

Pennsylvania Class Q-1

Wheel Arrangement 4-6-4-4

Length overall, from coupler face to coupler face, 122 feet, 9¾ inches—Height, 15 feet, 6 inches

Cylinders, Front—23-inch diameter, 28-inch stroke. Rear—19½-inch diameter, 26-inch stroke

Steam Pressure, 300 pounds per square inch

Driving Wheel Diameter, 77 inches

Weight on Driving Wheels, 354,700 pounds

Total Weight of Locomotive and Tender in Working Order, 1,027,870 pounds

Tractive Effort, 81,793 pounds (with Booster, 93,043 pounds)

Capacity of Tender, 82,640 pounds of Coal, 19,167 gallons of Water

Pennsylvania Class J-1

Length overall, from coupler face to coupler face, 117 feet, 8 inches—Height, 16 feet, 5½ inches

Cylinders, 29-inch diameter, 34-inch stroke

Steam Pressure, 270 pounds per square inch

Driving Wheel Diameter, 69 inches

Wheel Arrangement 2-10-4

Weight on Driving Wheels, 379,493 pounds

Total Weight of Locomotive and Tender in Working Order, 987,380 pounds

Tractive Effort, 95,100 pounds (With Booster, 110,100 pounds)

Capacity of Tender, 59,800 pounds of Coal, 21,000 gallons of Water

COAL-BURNING STEAM FREIGHT LOCOMOTIVE

The Pennsylvania Railroad Has in Service Nearly 4,400 Coal-Burning Steam Locomotives

COAL-BURNING STEAM PASSENGER LOCOMOTIVE

Pennsylvania Class K-4s

Length overall, from coupler face to coupler face, 83 feet—Height, 15 feet

Cylinders, 27-inch diameter, 28-inch stroke

Steam Pressure, 205 pounds per square inch

Driving Wheel Diameter, 80 inches

Wheel Arrangement 4-6-2

Weight on Driving Wheels, 209,300 pounds

Total Weight of Locomotive and Tender in Working Order, 541,500 pounds

Tractive Effort, 44,460 pounds

Capacity of Tender, 43,600 pounds of Coal, 11,300 gallons of Water.

PENNSYLVANIA RAILROAD IS WORLD'S LARGEST TRANSPORTATION SYSTEM

AS IT stands today, the Pennsylvania is the largest transportation system in the world, measured by the freight and passengers carried, the extent of facilities operated and the investment in road and equipment. It is owned by approximately 212,000 stockholders—more than any other railroad—and the stockholders have received a return on their investment in every year since 1847.

Approximately half the population of the country lives in territory accessible to the lines of the Pennsylvania system, and at least two-thirds of the total wealth and resources of the Nation are located in the fourteen States and District of Columbia which its lines directly serve.

The earliest of the lines now comprising The Pennsylvania Railroad Company was originally chartered as The Pennsylvania Railroad in 1823 by Colonel John Stevens, who thereby held the oldest charter under which any railroad project was ever undertaken. This line extended from Philadelphia to Columbia, Pa.

Various lines came into being in the early 1800's, and the first of

Pennsylvania Class M-1a

Length overall, from coupler face to coupler face, 108 feet, 2⅜ inches—Height, 15 feet, 6 inches

Cylinders, 27-inch diameter, 30-inch stroke

Steam Pressure, 250 pounds

Driving Wheel Diameter, 72 inches

Wheel Arrangement 4-8-2

Weight on Driving Wheels, 271,000 pounds

Total Weight of Locomotive and Tender in Working Order, 768,360 pounds

Tractive Effort, 64,550 pounds

Capacity of Tender, 63,000 pounds of Coal, 22,090 gallons of Water

COAL-BURNING STEAM Freight or Passenger LOCOMOTIVE

these in the Middle Western territory of the present Pennsylvania Railroad Company was chartered in Indiana on January 27, 1836, and was known as the Madison and Indianapolis Railroad. It was the first railroad west of the Alleghenies and still is a widely known line, because of the engineering feat in building the track up the Madison Hill at a grade of 5.89 per cent—steepest on any steam railroad in the United States.

Today, the railroads of America retain their place of leadership for many reasons, chiefly, that, for the great majority of purposes, they provide what the public considers to be the most advantageous and useful combination of safety, speed, comfort, regularity, frequency and low cost of service offered by any public carrier, together with the ability to operate practically without regard to weather conditions.

Always Searching for New Things—AND FINDING THEM

IN the fifteen years following the panic year of 1929, the Pennsylvania Railroad spent nearly a billion dollars on improvements. In five of the present war years alone, more than $300,000,000 went into betterment expenditures, and millions more are being spent as the management constantly endeavors to invent better equipment, facilities and methods of operation and to improve those already in use.

Outstanding among the improvements on the Pennsylvania are the induction train telephone system, the "cab signal", centralized traffic control, and air-conditioning of passenger cars. The cab signal reproduces inside the engines cab the indications of the external wayside signals.

Centralized traffic control makes it possible to govern the movements of distant trains by signals and switches controlled by an operator at a central point, who has before his eyes a diagram of the trackage, with the positions of the trains shown by miniature lights.

The Pennsylvania Railroad was among the pioneers in the use of air-conditioning, applying it to passenger cars when the cost was almost prohibitive. Through constant research and improvement, air-conditioning has become general, far advanced from its original conception.

The first application to its main line operations of train-to-train and train-to-tower telephone communication was announced in August, 1944, by the Pennsylvania Railroad. The Pennsylvania's induction train telephone system, providing instantaneous and continuous communication between moving trains and wayside towers and between moving trains themselves, is being installed on two main line four-track divisions, covering 245 miles of line, between Harrisburg and Pittsburgh, Pa.

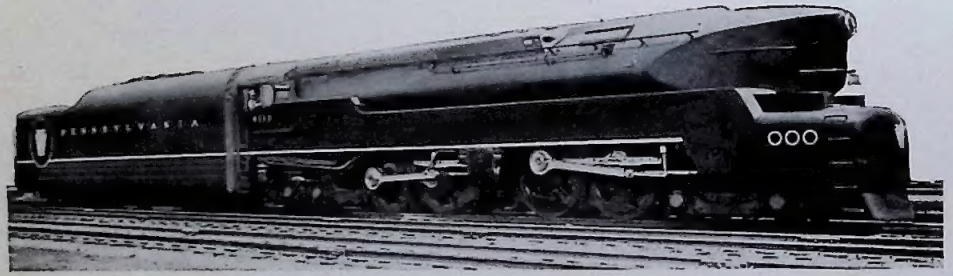
This new installation of the induction train telephone, which was developed in collaboration with the Union Switch and Signal Company and has been in experimental use since June, 1942, on the Belvidere-Delaware Branch in northern New Jersey, will give the railroad opportunity to work out the adaptation of the new system to conditions in one of the heaviest railroad traffic areas of the country.

The induction telephone will be utilized in conjunction with the most modern signaling and safety devices, such as automatic block signals and locomotive cab signals, and will cost more than $1,000,000. Approximately 300 passenger and freight locomotives, 90 freight train cabin cars, and six strategically located wayside towers along the 245 mile stretch of main line track are being equipped with train telephone.

Towermen in wayside towers can talk over the telephone with train crews moving in their areas, even though many miles distant. On freight trains, the conductor in the cabin car and the engineman in the locomotive may communicate at will, and the crew of one train may talk with the crew of another several miles distant.

The most recent refinements in the induction telephone were brought about through the pooling of the facilities, laboratory research and engineering resources of the Union Switch and Signal Company and the General Electric Company. The train telephone utilizes high frequency alternating electric currents, transmitted by induction to the rails and to existing wires on poles parallel to the tracks. The transmission paths are therefore confined entirely to railroad property.

Class T-1



Four-Cylinder Coal-Burning Steam Passenger Locomotive

PENNSYLVANIA RAILROAD

Always Searching for New Things—and Finding Them